

PHYSICS 106 (Spring 2004)  
FINAL EXAM - VERSION A

NAME \_\_\_\_\_

RECITATION \_\_\_\_\_

INSTRUCTIONS:

- Please fill in your computer answer sheet filling in the circle on the sheet corresponding to the letters of numbers with a #2 pencil as follows:

In the NAME grid fill in your last name, leave one blank space, then your first name.

Write your ID number in the IDENTIFICATION NUMBER section of the sheet.

Write your recitation section number in the space K,L in the SPECIAL CODES section. The recitation section number should be preceded by a 0 (e.g. section 1 is written as 01).

Fill in the VERSION of this exam on #103 of the answer sheet.

In the next two hours you need to answer all 40 questions for 5 points each. For each question, you should indicate in the answer sheet the best choice. Note that the multiple-choice questions on this exam are numbered 41 through 80. Check your answers carefully, making sure your answers are entered under the correct number, as no changes will be made after the exam is turned in. At the end of the exam you will have to hand in your notes, your exam paper and the answer sheet.

- You are allowed to use three pages of handwritten notes and a calculator.

41. On a day when the speed of sound in air is 340 m/s, a lightning bolt is observed and the resultant thunderclap is heard 3 seconds afterwards. About how far away was the lightning bolt?
- A. 1700 m
  - B. 88,000 m
  - C. 68 m
  - D. 1020 m
  - E. 113 m
42. The principle of superposition tells us that, if two waves cross paths,
- A. the higher frequency wave will be on top.
  - B. the net frequency is the sum of the individual wave frequencies.
  - C. the net frequency is the sum of the individual wave speeds.
  - D. the net displacement is the sum of the individual wave displacements.
43. Which of the following is a longitudinal wave?
- A. a light wave
  - B. a wave on string under tension
  - C. a sound wave in a gas
  - D. none of these
  - E. all of these
44. Suppose the velocity of waves on a particular rope under a tension of 10 N is 12 m/s. If the tension is increased fourfold to 40 N what will be the new velocity of waves on the rope?
- A. 48 m/s.
  - B. 24 m/s.
  - C. 18 m/s.
  - D. 12 m/s.
  - E. 6 m/s.
45. An organ pipe of length 6.0 m has one end closed. The two longest possible wavelengths for standing waves inside the pipe are
- A. 6 m and 3 m.
  - B. 12 m and 6 m.
  - C. 12 m and 4 m.
  - D. 24 m and 8 m.
  - E. 3 m and 1.5 m.

46. Which of the following is not an electromagnetic wave?
- A. Sound
  - B. Microwaves
  - C. Infrared
  - D. X-ray
  - E. Light
47. The primary difference between x-rays and visible light is that
- A. they travel in air at different speeds.
  - B. one is a wave and the other is a photon.
  - C. x-rays are not electromagnetic waves.
  - D. light is not electromagnetic wave.
  - E. they have different frequencies.
48. The Doppler effect refers to changes in a sound wave's
- A. amplitude
  - B. duration
  - C. frequency
  - D. speed
49. A beam of orange light ( $\lambda = 600 \text{ nm}$ ) illuminates two slits that are closely spaced. The resulting intensity pattern is a series of bright and dark fringes. What happens to the intensity pattern if we now change to blue ( $\lambda = 480 \text{ nm}$ ) light?
- A. Nothing changes.
  - B. The series of bright and dark fringes changes to circular fringes.
  - C. The series of bright and dark fringes spreads out.
  - D. The series of bright and dark fringes gets closer together.
  - E. The series of bright and dark fringes disappears.
50. A thin layer of oil floats on a water puddle. An observer sees a colored pattern due to interference of light reflected from
- A. the oil/air interface AND the oil/water interface.
  - B. ONLY the oil/air interface.
  - C. ONLY the oil/water interface.
  - D. the oil/air interface OR the oil/water interface, but not both.

51. A fish looks up through the smooth surface of the water at a bear directly above it. To the fish, the bear appears to be
- A. further away than it really is.
  - B. closer to the point directly above the fish than it really is.
  - C. exactly where it really is.
  - D. the bear cannot be seen by the fish, due to total internal reflection.
52. A woman 1.8 m in height wants a plane mirror so that she can view her full height. The minimum vertical size of such a mirror is
- A. 3.6 m.
  - B. 1.8 m.
  - C. 0.9 m.
  - D. 0.45 m.
  - E. impossible to say without knowing the viewing distance.
53. An object is placed 15 cm in front of a diverging lens of focal length -10 cm. The image will be located
- A. 0.167 cm in front of the lens.
  - B. 3.0 cm behind the lens.
  - C. 3.0 cm in front of the lens.
  - D. 6.0 cm in front of the lens.
  - E. 6.0 cm behind the lens.
54. A 1 cm object is placed 20 cm from a lens. The lens forms a real and inverted image of size 4.0 cm. What is the focal length of the lens?
- A. 8.0 cm.
  - B. 12 cm.
  - C. 16 cm.
  - D. 20 cm.
  - E. 24 cm.
55. The gauge pressure in the tires of a car is 100 kPa. The area of each tire in contact with the road is  $120 \text{ cm}^2$ . What is the mass of the car in kg?
- A. 240 kg
  - B. 480 kg
  - C. 960 kg
  - D. 1200 kg
  - E. 1480 kg

56. The speed of light in a certain type of transparent plastic is 30% slower than the speed of light in air. The index of refraction for that type of plastic is about
- A. 1.33.
  - B. 1.25.
  - C. 1.43.
  - D. 2.25.
57. For most elements, an atom has
- A. no neutrons in the nucleus.
  - B. more protons than electrons.
  - C. less neutrons than electrons.
  - D. just as many electrons as protons.
  - E. just as many neutrons as electrons.
58. When the electron loses its charge, then it
- A. becomes a neutron..
  - B. is still an electron but doesn't have its charge.
  - C. is now repelled by protons.
  - D. becomes a photon.
  - E. ... it is impossible to remove a charge from an electron.
59. What is "uncertain" in the Heisenberg Uncertainty principle?
- A. The value of the particle's position when the particle's momentum is known precisely.
  - B. The time period of the wave describing the particle.
  - C. The energy of the particle when it has wave properties.
  - D. The exact number of protons in the nucleus.
  - E. The value of the Planck's constant.
60. If  $h$  = Planck's constant, the frequency of light emitted when an atom makes a transition is equal to
- A. the energy of the initial atomic state divided by  $h$ .
  - B. the energy of the final atomic state divided by  $h$ .
  - C. the difference in the energies of the initial and final atomic states divided by  $h$ .
  - D. the ionization energy of the atom divided by  $h$ .
  - E. the frequency of revolution of the electron in its lowest energy orbit.

61. The helium atom has one more electron than hydrogen. The chemical properties differ because helium
- A. is more reactive since it has two electrons that can form chemical bonds.
  - B. is much less reactive since its two electrons form a stable closed shell.
  - C. and hydrogen are equally reactive since chemical bonding has nothing to do with the number of electrons.
  - F. has neutrons in the nucleus.
62. The density of aluminum is  $2700 \text{ kg/m}^3$ . An aluminum block has a mass of 0.50 kg. The buoyant force exerted on this block when it is completely submerged in water of density  $1000 \text{ kg/m}^3$  is approximately:
- A. 2.4 N.
  - B. 1.2 N.
  - C. 0.91 N.
  - D. 0.093 N.
  - G. 1.85 N.
63. Comparing the electrostatic force and the gravitational force we can say that
- A. both have the same dependence on distance, both involve attraction and repulsion but the gravitational force is stronger.
  - B. both have the same dependence on distance, both involve attraction and repulsion but the electrostatic force is stronger.
  - C. both have the same dependence on distance, the electrostatic force can be either attractive or repulsive while the gravitational force is only repulsive, and the electrostatic force is weaker.
  - D. both have the same dependence on distance, the electrostatic force can be either attractive or repulsive while the gravitational force is only attractive, and the electrostatic force is stronger.
  - E. the electrostatic force falls off more rapidly with distance, the electrostatic force can be either attractive or repulsive while gravitation is only attractive and the electrostatic force is stronger.

64. A household circuit rated at 120 Volts is protected by a fuse rated at 12 amps. What is the maximum number of 60 watt light bulbs which can be lit simultaneously in parallel in this circuit without blowing the fuse?
- A. 4
  - B. 8
  - C. 18
  - D. 20
  - E. 24
65. A vertical straight wire carries a current from south to north. The resulting magnetic field lines are
- A. parallel to the wire from south to north.
  - B. parallel to the wire from north to south.
  - C. closed circles perpendicular to the wire directed clockwise as viewed from the south.
  - D. closed circles perpendicular to the wire directed counterclockwise as viewed from the south.
  - D. straight lines perpendicular to the wire.
66. A transformer has 200 turns on the primary and 20 turns on the secondary. The primary is connected to an AC current source of 100 millivolts. The voltage in the secondary coil will be
- A. 10 millivolts.
  - B. 20 millivolts.
  - C. 1000 millivolts.
  - D. 4000 millivolts.
  - E. zero.
67. A 250 kg sack of potatoes falls from an airplane. As the velocity of the falling sack increases, so does the air resistance on it. When the air resistance equals 250 kg, the real acceleration  $a$  of the sack will be
- A. infinite.
  - B.  $9.8 \text{ m/s}^2$ .
  - C.  $9.8 \text{ m/s}$ .
  - D.  $4.9 \text{ m/s}^2$ .
  - E. zero

68. A wooden block slides down a rough incline. Which of the following statements is true?
- A. The kinetic energy of the block is decreasing.
  - B. The gravitational potential energy of the block is increasing.
  - C. The mechanical energy of the block is constant.
  - D. The mechanical energy of the block is increasing.
  - E. The mechanical energy of the block is decreasing.
69. A 5.0-kg cat runs to the left at 10 m/s and a 10-kg dog runs to the right at 6.0 m/s. The total kinetic energy is
- A. -125 Joule.
  - B. +125 Joule
  - C. 0 Joule.
  - D. 375 Joule.
  - E. 430 Joule.
70. A car is driven between two nearby towns at an average speed of 50 miles/hour. The magnitude of the average velocity of the car
- A. will always be the same as the average speed.
  - B. will always be less than the average speed.
  - C. will be the same as or less than the average speed.
  - D. will be the same as or greater than the average speed.
  - E. will always be greater than the average speed.
71. In order to find the depth of a well, you drop a stone into it and time its fall. It hits the water after falling for 2 s. The depth of the well is about
- A. 2 m.
  - B. 10 m.
  - C. 20 m.
  - D. 40 m.
  - E. 60 m
72. A ball is thrown upward with an initial velocity of 30 m/s. It will reach its maximum height in approximately
- A. 1 s.
  - B. 1.5 s.
  - C. 2 s.
  - D. 2.5 s.
  - E. 3 s.



73. A crate is acted upon by a net force of 20 N. An acceleration of  $5.0 \text{ m/s}^2$  results. The weight of the crate is

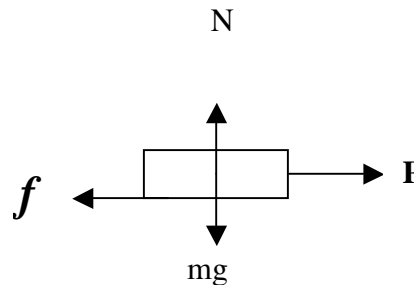
A. 20 N.                                      B. 10 N.                                      C. 100 N.  
D. 200 N.                                      E. 40 N.

74. An object with a kinetic energy of 50 J is stopped in a distance of 0.10 m. The average force that stops the object is

A. 0.5 N.  
B. 50 N.  
C. 500 N.  
D. 5,000 N.  
E. 50,000 N

75. A boy pulls a wooden box of mass  $m$  along a rough horizontal floor at constant speed by means of a force  $P$ . The force diagram for the box is shown below. Which of the following must be true, where  $f$  and  $N$  are, respectively, the magnitudes of frictional and normal forces?

A.  $P > f$  and  $N = mg$   
B.  $P = f$  and  $N = mg$   
C.  $P > f$  and  $N < mg$   
D.  $P = f$  and  $N > mg$   
E.  $P < f$  and  $N = mg$



76. A child runs at  $4.0 \text{ m/s}$  and jumps onto a sled, initially at rest. If the child's mass is 36 kg, and if the child and sled slide off together at  $2.0 \text{ m/s}$  after the collision, the sled's mass is

A. 6 kg                                      B. 12 Kg                                      C. 27 kg  
D. 36 kg                                      E. 48 kg

77. Your mass is 50 kg. Suppose you are standing on a scale in an elevator which starts moving down and increases its speed at the rate of 2 m/s every second. What would be the reading on the scale?
- A. 600 N                      B. 500 N                      C. 400 N  
D. 100 N                      E. 0
78. An auto, starting from rest, undergoes constant acceleration and covers a distance of 1000 meters. The final speed of the auto is 80 meters/sec. How long does it take the car to cover the 1000 meters?
- A. 12.5 s                      B. 25 s                      C. 32 s  
D. 50 s                      E. 80 s
79. Two displacement vectors are added: one of length 2.0 m and one of length 3.0 m. Not knowing the respective directions, we can say that the length of the sum of the vectors will be
- A. 5.0 m  
B. between 5.0 m and 1.0 m  
C. between 5.0 m and 3.0 m  
D. less than 1.0 m  
E. 2.0 m
80. A tube with a radius of 4.2 cm is holding oil with a density of  $0.92 \text{ g/cm}^3$ . The pressure in the oil at a depth of 64 cm from the top of the surface is
- A.  $5.8 \times 10^2 \text{ Pa}$   
B.  $5.8 \times 10^3 \text{ Pa}$   
C.  $1.0 \times 10^2 \text{ Pa}$   
D.  $1.0 \times 10^4$   
E.  $1.7 \times 10^5 \text{ Pa}$